
Loss plan

End-to-end connection loss is one of the most important aspects to consider when planning private networks. That is because end-to-end connection loss is a major element in controlling transmission performance parameters, such as received volume, echo, noise, and crosstalk. In digital networks, loss provisioning is a function of network switching. Therefore, in private networks the loss plan of the PBX is fundamental to the overall network loss design.

The insertion loss of a PBX connection is defined as the level difference between the power delivered from a reference signal source connected across an input port to a measuring instrument connected across an output port, with

- the path through the PBX connected
- the path through the PBX replaced by a direct connection

For insertion loss tests, both the signal source and the measurement instrument are terminated in 600 ohm. The reference signal source frequency is between 1000 Hz and 1020 Hz for North America, and between 800 Hz and 820 Hz for most other locations. The insertion loss values are expressed as absolute loss between interface ports and, within the limits of overload and tracking error, are independent of the signal level.

Loss plan for μ -Law applications

General

The insertion losses between intelligent peripheral equipment (IPE) ports, IPE and peripheral equipment (PE) ports, and analog and digital ports are connection-specific to be compatible with end-to-end network connection loss requirements. The Meridian 1 loss specifications are in agreement with North American standards, which are formulated to provide satisfactory end-to-end performance for connections within private networks and connections between private and public networks. These specifications include evolving standards for connections involving ISDN-compatible stations (ICS) and Integrated Services (IS) trunks.

The loss plan strategy for IPE combines electrical inserted loss with terminal acoustic parameters for optimum transmission performance. This strategy enables IPE to accommodate a variety of voice terminals while maintaining acoustic equivalence with traditional telephones.

Some connections between digital and analog ports have asymmetrical loss to conform to network loss plans or to provide compatibility with the transmission characteristics of various voice terminals. This asymmetry is resolved at a remote point, for example another switch, in the overall connection.

A satellite tie trunk connects a satellite or tributary PBX (defined as a PBX that does not have its own directory number for incoming calls) to the main PBX. Satellite tie trunks, in some connections, require different loss treatment than nonsatellite tie trunks.

Note: In this context, the term *satellite* has no relationship to, and should not be confused with, an earth-orbiting transponder or circuits associated with an earth orbiting transponder.

Trunk options

To accommodate specific network and facility characteristics, you can select various options for Meridian 1 analog trunk ports. These options lead to variations in the loss plan as follows:

— Transmission class of service (COS):

Note: COS is the acronym used for transmission class of service in Electronic Industry Association (EIA) and Telecommunications Industry Association (TIA) standards.

Analog trunks are assigned one of the following class of service options:

- via net loss (VNL) for facilities with loss proportional to length
- non-VNL, as follows:
 - transmission compensated (TRC) for 2-wire non-VNL facilities with a loss of 2 dB or greater, or for which impedance compensation is provided, or for a 4-wire non-VNL facility
 - nontransmission compensated (NTC) for 2-wire non-VNL facilities with a loss of less than 2 dB or when impedance compensation is not provided

Note: Class-of-service options for IPE are available with X11 release 17 or later software.

— Signaling arrangements:

Depending on signaling arrangements, analog tie trunks may interface with a Meridian 1 through equipment compatible with E&M trunks or with loop dial repeater (LDR) trunks.

- IPE LDR tie trunks utilize a loss plan compatible with industry standards for tie trunks.
- PE LDR tie trunk loss insertion is the same as for PE central office (CO) trunks.
- LDR trunks for public switched telephone network (PSTN) access—for example, direct inward dial (DID) service—follow the loss plan for CO trunks.

— Facility termination:

IPE E&M tie trunks may be configured to interface 4-wire or 2-wire facility terminations.

Note: Facilities associated with the Northern Telecom Electronic Switched Network (ESN) offering for dialing features are recommended to be 4-wire for optimum transmission; thus, the 4-wire option is often referred to as the ESN option and the 2-wire as the non-ESN option. The presence or absence of the ESN package does not constrain the selection of the facility termination option.

- With the 4-wire (ESN) option invoked, the loss insertion in each direction is 0.5 dB less than for the 2-wire (non-ESN) option.
- PE E&M tie trunks (including satellite tie trunks) with QPC237C or later vintage are compatible with the loss requirements of 4-wire facility terminations (as recommended for ESN applications) and are reflected thus in the loss plan; for earlier vintages and 2-wire PE E&M tie trunks, the loss is 0.5 dB more in each direction.

Loss plan specifications

The loss plan tables are in a matrix format. The transmission direction of the loss values is shown by arrows. The values are independent of the originating or terminating function of the ports connected. Positive values denote loss, negative values denote gain. For example:

- In **Table 1** (IPE ports to IPE ports), the electrical loss from an E&M tie trunk to an analog telephone is 3.5 dB; in the reverse direction the electrical loss is 2.5 dB. (If the trunk is optioned for 2-wire facility termination, the losses are 4 and 3 dB, respectively.)
- In **Table 2** (digital ports to IPE ports), the electrical loss from a digital tie trunk port to an analog E&M tie trunk is 3 dB; in the reverse direction the electrical loss has a negative value of -3 dB, which indicates a 3 dB gain.

For simplicity, **Tables 1** through **6** present the loss plan for system default settings as follows:

IPE E&M tie trunk:	VNL, 4-wire
IPE LDR tie trunk:	TRC
IPE satellite E&M tie trunk:	TRC, 2-wire
IPE CO (local) trunk:	TRC
IPE TO (tandem or IC access) trunk:	VNL
PE E&M tie trunk:	VNL
PE satellite tie trunk:	TRC
PE CO (local) trunk:	TRC
PE TO (tandem, IC access) trunk:	VNL

Tables 1 through **6** provide loss values measured in decibels (dB), for connections between IPE ports (line and analog trunk ports), digital ports (PRI or DTI ports), and PE ports (line and analog trunk ports), as noted here:

	IPE ports	Digital ports	PE ports
IPE ports	Table 1		
Digital ports	Table 2	Table 3	
PE ports	Table 4	Table 5	Table 6

The complete loss values for the class-of-service options (VNL, TRC, NTC) are presented in **Tables 1** through **6**. The loss values given for IPE tie trunks are based on the selection of the 4-wire facility termination option; those for IPE satellite trunks are based on the selection of the 2-wire facility termination option. Digital ports are not shown because the loss between analog trunks and digital ports is the same for all classes of service and is also covered in **Tables 1** through **6**.

Note 1: The losses presented in **Tables 1** through 6 for connections to, from, and between IPE analog line ports reflect a 2 dB reduction in the electrical loss in the transmission direction to the line card. This reduction is implemented in cards shipped after October 1991 to accommodate the longer station loops being installed in distributed customer environments.

Note 2: The toll office values in **Tables 1** through 6 reflect a trunk that is connected to an office in the public switched network with a higher rank than the local serving office. In general, this trunk connects to a local access and transport area (LATA) tandem or to an interexchange carrier point of presence (IC POP).

Tables 1 through 6 show the loss plan for line and trunk IPE port connections.

Table 1
Electrical loss—IPE ports to IPE ports (Part 1 of 2)

IPE port	IPE port (COS)	Class**	Analog station		Analog off-prem station		Meridian digital set		ISDN terminal		2W E&M tie* (NTC)		2W E&M tie* (TRC)		4W E&M tie* (VNL)	
			ONS	↓	OPS	↓	D/ONS	↓	ICS	↓	A/TT	↓	A/TT	↓	S/ATT	↓
Analog station	→		4													
		ONS	←	4	—		—		—		—		—		—	
Analog off-prem station	→		1.5		1											
		ONS	←	1.5	1		—		—		—		—		—	
Meridian digital set	→		0.5		0											
		D/ONS	←	3.5	3		0		—		—		—		—	
ISDN terminal	→		6.5		0		6		0							
		ICS	←	3.5	—3		0		0		—		—		—	
2W E&M tie* (NTC)	→		1		0.5		0.5		—2.5		1					
		A/TT	←	3	2.5		—0.5		—0.5		1		—		—	
2W E&M tie* (TRC)	→		1		0.5		0.5		—2.5		1		1			
		A/TT	←	3	2.5		—0.5		—0.5		1		1		—	
4W E&M tie* (VNL)	→		3.5		3		3		—3		0.5		0.5		0	
		A/TT	←	2.5	2		—1		—1		0.5		0.5		0	
LDR tie (NTC)	→		0.5		0		0		—6		0.5		0.5		0	
		A/TT	←	0.5	0		—3		—3		1.5		0.5		0	
LDR tie (TRC)	→		0.5		0		0		—6		0.5		0.5		0	
		A/TT	←	0.5	0		—3		—3		0.5		0.5		0	
LDR tie (VNL)	→		0.5		0		0		—6		0.5		0.5		0	
		A/TT	←	0.5	0		—3		—3		0.5		0.5		0	
CO/FX/WATS (NTC)	→		0.5		0		0		—6		0.5		0.5		3	
		A/CO	←	0.5	0		—3		—3		1.5		0.5		1	
CO/FX/WATS (TRC)	→		0.5		0		0		—6		0.5		0.5		0	
		A/CO	←	0.5	0		—3		—3		0.5		0.5		0	
Toll office (VNL)	→		4.5		4		4		1		3.5		3.5		0	
		A/TO	←	4.5	4		1		4		4.5		1.5		0	

*E&M tie trunk transmission category is 4-wire; satellite tie trunk is 2-wire.

**Class (for example, ONS and ICS) denotes Telecommunications Industry Association (TIA) port designation for cross-reference purposes.

Table 1
Electrical loss—IPE ports to IPE ports (Part 2 of 2)

IPE port	IPE port (COS) Class**	LDR tie (NTC)	LDR tie (TRC)	LDR tie (VNL)	CO/FX/ WATS (NTC)	CO/FX/ WATS (TRC)	Toll office (VNL)
		ONS ↑ ↓	OPS ↑ ↓	D/ONS ↑ ↓	ICS ↑ ↓	A/TT ↑ ↓	A/TT ↑ ↓
Analog station	→ ONS ←	—	—	—	—	—	—
Analog off-prem station	→ ONS ←	—	—	—	—	—	—
Meridian digital set	→ D/ONS ←	—	—	—	—	—	—
ISDN terminal	→ ICS ←	—	—	—	—	—	—
2W E&M tie* (NTC)	→ A/TT ←	—	—	—	—	—	—
2W E&M tie* (TRC)	→ A/TT ←	—	—	—	—	—	—
4W E&M tie* (VNL)	→ A/TT ←	—	—	—	—	—	—
LDR tie (NTC)	→ A/TT ←	1 1	—	—	—	—	—
LDR tie (TRC)	→ A/TT ←	1 1	1 1	—	—	—	—
LDR tie (VNL)	→ A/TT ←	1 1	1 1	1 1	—	—	—
CO/FX/WATS (NTC)	→ A/CO ←	1 1	1 1	1 1	1 1	—	—
CO/FX/WATS (TRC)	→ A/CO ←	1 1	1 1	1 1	1 1	1 1	—
Toll office (VNL)	→ A/TO ←	1 1	1 1	1 1	1 1	1 1	1 1

*E&M tie trunk transmission category is 4-wire; satellite tie trunk is 2-wire.

**Class (for example, ONS and ICS) denotes Telecommunications Industry Association (TIA) port designation for cross-reference purposes.

Table 2
Electrical loss—digital ports to IPE ports

Digital port	IPE port (COS)	Class**	Analog set		Analog OPS		Meridian digital set		ISDN termina l		E&M tie*		Satellite tie*		CO/FX/ WATS		Toll office	
			ONS	↓	OPS		D/ONS	↓	ICS	↓	A/TT	↓	S/ATT	↓	A/CO	↓	A/TO	↓
Tie		→	8.5		6		8		0		3		6.5		3		3	
		D/TT ←	2.5		0		-1		0		-3		0.5		-3		-3	
Satellite tie*		→	2.5		2		2		-3		0		0.5		0		3	
		S/DTT ←	2.5		2		-1		0		0		0.5		0		3	
CO/FX/WATS/DID		→	2.5		0		2		-3		2		0.5		0		3	
		D/CO ←	2.5		0		-1		0		2		0.5		0		3	
Toll office		→	8.5		0		8		3		3		6.5		6		6	
		FX/WATS/DID D/TO ←	2.5		0		-1		0		-3		0.5		0		0	
Primary rate interface		→	6.5		0		6		0		3		6.5		3		3	
		IST ←	3.5		0		0		0		0		0.5		-3		-3	

*E&M tie trunk transmission category is 4-wire; satellite tie trunk is 2-wire.

**Class (for example, ONS and ICS) denotes TIA port designation for cross-reference purposes.

Table 3
Electrical loss—digital port to digital ports

Digital port	Digital port (COS)	Class*	Tie		Satellite tie		CO/FX/WATS		Toll office		Primary rate interface	
			D/TT	↓	S/DTT	↓	D/CO	↓	D/TO	↓	IST	↓
Tie		→	0									
		D/TT ←		0	—		—		—		—	
Satellite tie		→	0		0							
		S/DTT ←		6	0		—		—		—	
CO/FX/WATS /DID		→	0		0		3					
		D/CO ←		6	0		3		—		—	
Toll office		→	0		6		6		0			
		FX/WATS/DID D/TO ←		0	0		0		0		—	
Primary rate interface		→	0		6		3		0		0	
		IST ←		0	0		0		0		0	

*Class (for example, D/TT and D/CO) denotes TIA port designation for cross-reference purposes.

Table 4
Electrical loss—IPE ports to PE ports

		PE port (COS)	Analog set		Analog off-prem set		E&M tie* (NTC)		E&M tie* (TRC)		E&M tie* (VNL)		CO/FX/ WATS (NTC)		CO/FX/ WATS (TRC)		CO/FX/ WATS (VNL)	
Class**			ONS		OPS		A/TT		A/TT		A/TT		A/CO		A/CO		A/CO	
IPE port (COS)			↑	↓	↑	↓	↑	↓	↑	↓	↑	↓	↑	↓	↑	↓	↑	↓
Analog station		→	4.5		0.5		0		0		2		0.5		0.5		4.5	
	ONS	←		4.5		0.5		0		0		2		0.5		0.5		4.5
Analog		→	2		0		-0.5		-0.5		2		0.5		0.5		0.5	
Off-Premise Station		OPS	←		2		0		-0.5		-0.5		2		0.5		0.5	
Meridian digital set		→	1		1		-3.5		-3.5		-1.5		-3		-3		1	
	D/ONS	←		4		4		-0.5		-0.5		1.5		0		0		4
ISDN terminal		→	7		0		-0.5		-3.5		1.5		-3		-3		4	
	ICS	←		4		-3		-3.5		-6.5		-1.5		-6		-6		1
2-W E&M tie*		→	1.5		1.5		0		0		0		1.5		0.5		4.5	
(NTC)		A/TT	←		3.5		3.5		0		0		3.5		0.5		3.5	
2-W E&M tie*		→	1.5		1.5		0		0		0		0.5		0.5		0.5	
(TRC)		A/TT	←		3.5		3.5		0		0		0.5		0.5		0.5	
4-W E&M tie*		→	4		4		-0.5		-0.5		-0.5		1		0		0	
(VNL)		A/TT	←		3		3		-0.5		-0.5		3		0		0	
LDR tie		→	1		1		0.5		0.5		0.5		1		1		1	
(NTC)		A/TT	←		1		1		0.5		0.5		1		1		1	
LDR tie		→	1		1		0.5		0.5		0.5		1		1		1	
(TRC)		A/TT	←		1		1		0.5		0.5		1		1		1	
LDR tie		→	1		1		0.5		0.5		0.5		1		1		1	
(VNL)		A/TT	←		1		1		0.5		0.5		1		1		1	
CO/FX/WATS		→	1		1		0.5		0.5		2.5		1		1		1	
(NTC)		A/CO	←		1		1		0.5		0.5		1		1		1	
CO/FX/WATS		→	1		1		0.5		0.5		0.5		1		1		1	
(TRC)		A/CO	←		1		1		0.5		0.5		1		1		1	
Toll office		→	5		5		2.5		2.5		0.5		1		1		1	
(VNL)		A/TO	←		5		5		2.5		2.5		1		1		1	

*IPE E&M tie trunk transmission category is 4-wire; satellite tie trunk is 2-wire.

**Class (for example, ONS and OPS) denotes TIA port designation for cross-reference purposes.

Table 5
Electrical loss—digital ports to PE ports

Digital port (COS)	Class*	PE port (COS)	Analog set		Analog OPSt		E&M tie		Satellite tie		CO/FX/ WATS		Toll office	
			ONS		OPS		A/TT		S/ATT		A/CO		A/TO	
			↑	↓	↑	↓	↑	↓	↑	↓	↑	↓	↑	↓
Tie	→		9		6		6.5		4.5		6		3	
	D/TT ←			3		0		0.5		-1.5		0		-3
Satellite tie	→		3		2		0.5		-1.5		0		3	
	S/DTT ←			3		2		0.5		-1.5		0		3
CO/FX/WATS/DID	→		3		0		2.5		0.5		0		3	
	D/CO ←			3		0		2.5		0.5		0		3
Toll office FX/WATS/DID	→		9		6		6.5		4.5		6		6	
	D/TO ←			3		0		0.5		-1.5		0		0
Primary rate interface	→		7		7		6.5		4.5		3		3	
	IST ←			4		4		0.5		-1.5		-3		-3
*Class (for example, ONS and OPS) denotes TIA port designation for cross-reference purposes.														

Table 6
Electrical loss—PE ports to PE ports

		PE port (COS)	Analog set	Analog off-prem set	E&M tie (NTC)	E&M tie (TRC)	E&M tie (VNL)	CO/FX/ WATS (NTC)	CO/FX/ WATS (TRC)	Toll office (VNL)
Class*			ONS	OPS	A/TT	A/TT	A/TT	A/CO	A/CO	A/TO
PE port (COS)			↑ ↓	↑ ↓	↑ ↓	↑ ↓	↑ ↓	↑ ↓	↑ ↓	↑ ↓
Analog set	→		5							
ONS	←		5	—	—	—	—	—	—	—
Analog	→		5	1						
Off-Prem Sta'n	←		5	1						
E&M tie	→		0.5	0.5	0					
(NTC)	←		0.5	0.5	0	—	—	—	—	—
E&M tie	→		0.5	0.5	0	0				
(RTC)	←		0.5	0.5	0	0	—	—	—	—
E&M tie	→		2.5	2.5	0	0	0			
(VNL)	←		2.5	2.5	0	0	0	—	—	—
CO/FX/WATS	→		1	1	0.5	0.5	2.5	1		
(NTC)	←		1	1	0.5	0.5	2.5	1	—	—
CO/FX/WATS	→		1	1	0.5	0.5	0.5	1	1	
(TRC)	←		1	1	0.5	0.5	0.5	1	1	—
Toll office	→		5	5	2.5	0.5	0.5	1	1	1
(VNL)	←		5	5	2.5	0.5	0.5	1	1	1

*Class (for example, ONS and OPS) denotes TIA port designation for cross-reference purposes.

Table 7 shows the loss tolerance for all of the connections in **Tables 1** through 6.

Table 7
Insert loss tolerance

Type of connection	Insertion loss tolerance (dB)
Line to line	± 1.0
Line to analog trunk	± 0.7
Line to digital trunk	± 0.7
Analog trunk to analog trunk	± 0.7
Analog trunk to digital trunk	± 0.7
Digital trunk to digital trunk	± 0.2

Loss plan for conference connections

When three or more conferees that terminate on 2-wire ports are connected through a Meridian 1 conference bridge, the 2-wire terminations cause reflections that are compensated by added loss in the conference bridge. The added loss is a function of the number of 2-wire ports and the type of port. **Table 8** lists the port to port loss for conferences with three to six ports and IPE connections between analog lines and trunks.

Note: A maximum of three trunks are recommended on a conference connection.

Table 8
Loss insertion for conference connections

Connection (A-B)	Three ports		Four ports	
	Loss A-B (dB)	Loss B-A (dB)	Loss A-B (dB)	Loss B-A (dB)
Line to line	4.0	4.0	7.0	7.0
Line to CO trunk	0.5	0.5	3.5	3.5
Line to tie trunk	2.5	0.5	5.5	3.5
CO trunk to CO trunk	0.0	0.0	0.0	0.0
CO trunk to tie trunk	2.0	0.0	2.0	0.0
Tie trunk to tie trunk	2.0	2.0	2.0	2.0
Connection (A-B)	Five ports		Six ports	
	Loss A-B (dB)	Loss B-A (dB)	Loss A-B (dB)	Loss B-A (dB)
Line to line	8.5	8.5	10.0	10.0
Line to CO trunk	5.0	5.0	6.5	6.5
Line to tie trunk	7.0	5.0	8.5	6.5
CO trunk to CO trunk	1.5	1.5	3.0	3.0
CO trunk to tie trunk	3.5	1.5	5.0	3.0
Tie trunk to tie trunk	3.5	3.5	5.0	5.0

Loss plan for A-Law applications

The insertion loss values for connections between ports are location specific. If not modified for specific locations—for example, to meet approval requirements of a particular administration—the μ -Law loss plan applies. The insertion loss limits are listed in [Table 7](#).